



CIA Inspection Inc.

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# The Profiler

A NEWSLETTER OF INFORMATION FOR COKE DRUM OPERATORS

## New Strategy and Pricing Changes for the New Millennium

As CIA Inspection enters its seventh year of service inspecting coke drums, we have learned a great deal about how, why and where coke drums fail.

When we started out, little was known about the connection between drum distortion and failure location. Over the years, we have identified many trends that appear to be linked to subtle differences in drum design.

These differences, along with the various metallurgy that make up the current population of coke drums, creates wide variations in operational performance when pitted against the rigors of the coking cycle.

Combining these differences with increased production pressures, the industry is beginning to see an increased incidence of failure, even in relatively new drums. These trends and the increasing impact of lost production, place greater emphasis on the need for improved reliability.

The apparent rate of which vessel shape is changing, points to increased inspection frequency as an effective means of identifying and tracking trends earlier in the life of the vessel. These trends can then be used to aid in the prediction of when and where vessels are likely to fail.

Recognizing the potential for improved analysis through more frequent trending we are re-working our pricing structure to significantly lower the effective unit cost of a coke drum inspection. This allows our customers to benefit from our experience and well-established service at a much lower cost.

Our improvement in pricing combined with our newly opened US office and the introduction of a second inspection system offers increased flexibility at a lower cost to our growing client base. Please contact Rick Clark at 905-692-3678 regarding our new inspection programs and package pricing.

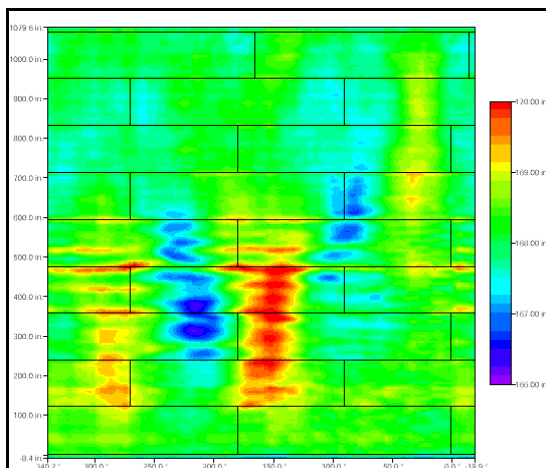
## Laser Scanning of New Coke Drums

To date, CIA Inspection has performed over 200 laser inspections of coke drums throughout the world ranging in age from new to over 40 years old. All

of them exhibit some form of distortion whether it be ovality or bulging. It is our experience that new drums are not nearly as perfect as imagined. Anomalies such as peaking of vertical welds and course-to-course mismatch along with built-in ovality are often found in brand new drums even before they are cycled for the first time!

formed all subsequent scans can be compared using CIA software specially designed to determine where and by how much the vessel is changing.

A recent inspection of four 1¼% Cr - ½% Mo coke drums illustrates how relatively new vessels can distort and change in a short period of time. The drums were operating for five years at the time CIA performed the laser scan. All four drums exhibited bulging (between 1.5" to 2") and ovality. Another inspection of brand new drums detected significant peaking of vertical welds. CIA benchmarked these 1¼% Cr-½% Mo vessels before they went into service. Because of the conditions identified during the initial scan, follow-up scans of these vessels have been conducted on an annual basis.



Laser scan of 5 year old 1¼% Cr - ½% Mo coke drum. Colors of the map represent radius; green is nominal while blue/violet represent smaller-than-nominal radii and yellow/orange/red represent larger radii (red represents bulges). Black grid represents weld seams.

Performing a benchmark laser scan before start-up is the best time to determine the as-built condition. Many things can happen to a drum from the time it leaves the fabricator's shop until it is installed in the structure at the site. If the opportunity for benchmarking a new drum has already passed, it is still advantageous to scan the drum as early as possible in its life. Once the benchmark scan has been per-

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## Laser Scanning of New Coke Drums

### OTHER OBSERVATIONS

CIA has observed that newer 1% Cr and 1¼% Cr drums often exhibit early signs of bulging, often after only 5 years or so of service. We believe that this is due to two causes:

- newer drums are being designed with thinner walls than older carbon or C-½% Mo drums;
- newer drums are running on shorter cycle times therefore being worked

harder than older drums.

These discussions and the few examples demonstrate the advantages of inspecting coke drums early in their life. Conscientious inspection of the high-risk areas will lead to improved reliability and ultimately extend the useful life of the vessel. Contact Rick Clark at 905-692-3678 for more information.

## Stress Analysis Capability

As written in our previous newsletter, CIA Inspection has now developed a method for applying finite element modeling tools to the laser-scanned profiles of coke drums to evaluate the stress concentrations caused by local distortions.

A load model representing the effects of cover gas pressure, hydrostatic head of the coke, and the thermal loads imposed during the quench cycle is applied to the finite element model.

This new tool can identify the location of the highest stress area in a drum and the weld section with the highest stress. This can tell operations/inspection which welds to monitor, as they are likely to crack first. This capability can also be used to identify the percentage increase in stress at any location. Other inputs to the stress analysis model, such as strain gauge or thermocouple data,

will improve the ability to quantify the impact of coke drum bulges on fatigue life and crack growth rate.

Recognizing the impact that drum distortions have on stress concentrations and fatigue life, it is clear that operators of coke drums can benefit through the long term monitoring of their coke drum surface profile. Identification and tracking of vessel profile combined with an engineering stress analysis can be a useful measure of long term reliability of coke drums.

Continued input from coke drum operators on actual failure incidence is helping to verify the stress analysis model, improve it's ability to highlight failure prone areas and, ultimately, to predict failure. For more information, please contact Rick Clark at 905-692-3678 or Daryl Rutt at 705-741-6336.



## See you at the API in San Diego

Some of the CIA Inspection staff in New Orleans – Daryl & Irene Rutt, Dave & Lora Stratton, Jacqueline & Rob Cameron taking a river cruise at the fall API in New Orleans. We will be attending the spring API conference in San Diego, California. We hope you will drop by our table at the Monday night reception. We have some new and exciting things happening at CIA in the new millenium. Ask us about them!

## Coking Corner – The Uses of Petroleum Coke

Fuel grade coke (shot or sponge) is used in the production of cement and with fluidized bed boilers (using limestone for sulfur removal) for generation of steam and electricity. The important properties for pulverized fuel coke are the cost per BTU, high HGI, and sulfur content.

**Metallurgy Uses** – some raw petroleum coke, if the sulfur is low enough, can be blended into feed for slot ovens which produce blast furnace coke. Petroleum coke increases the physical strength and density of the coke when blended with coal.

**Gasification** - partial oxidation of petroleum coke in a gasification process enables raw petroleum coke to be used to produce steam, electricity, or gas feedstocks for the petrochemicals industry.

**Other Uses** – some calcined petroleum coke is used in production of titanium dioxide (in the chloride process), production of carbon monoxide for production of plastics, as a feedstock for continuous particle thermal desulfurization for special low sulfur carbon raiser (steel ladle additive), or as carbon raiser in cast iron and steel making.

## Web Site Update

If you haven't checked out our web site lately – you should!

We've made some very interesting changes and we always welcome your comments!!! You can find us at [www.cia-inspection.com](http://www.cia-inspection.com).



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